B5

# TEST & ALIGNMENT PROCEDURES

FOR

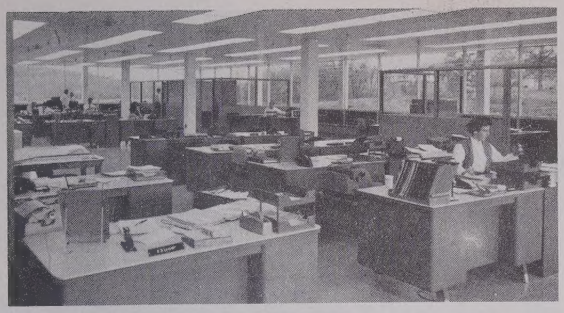
# TYPE 250A RX METER

**BOONTON RADIO COMPANY**

Green Pond Road Rockaway, New Jersey

U. S. A.

# New BRC Plant



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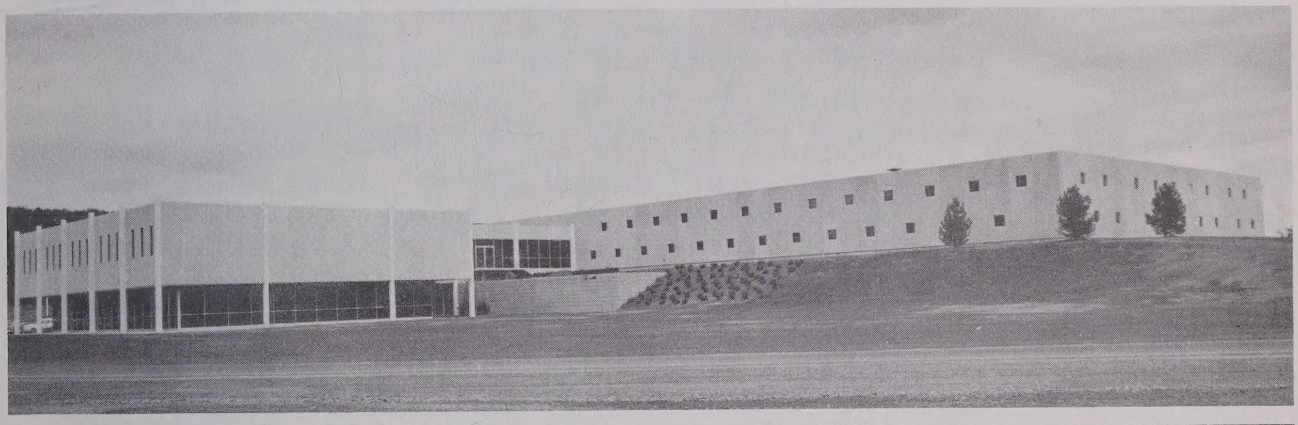

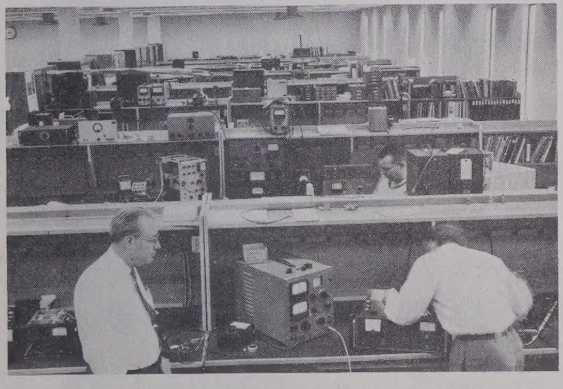

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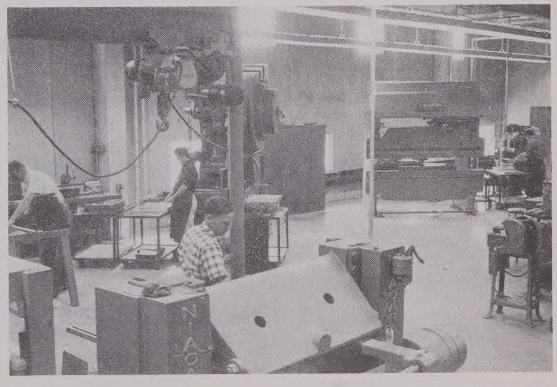

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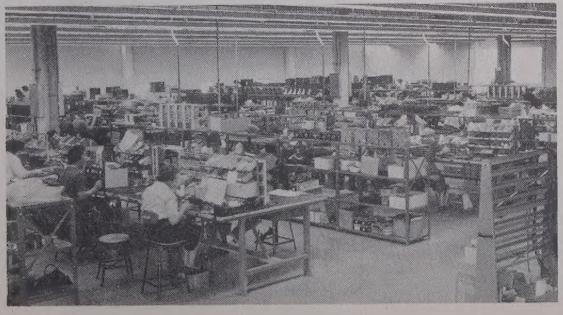

ASSEMBLY

INSPECTION

# INDEX TO RX METER INFORMATION IN THE BRC NOTEBOOK

YOUR ATTENTION IS INVITED TO THE FOLLOWING ARTICLES IN THE BRC NOTEBOOK TO SUPPLEMENT THE INFORMATION IN THIS MANUAL. COPIES OF THE NOTEBOOK ARE AVAILABLE THRU YOUR NEAREST -HP- SALES OFFICE.

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| 2 | RX METER BRIDGE TRIMMER ADJUSTMENT |
| 3 | TRANSMISSION LINE MEASUREMENTS WITH THE RX METER |
| 3 | A COAXIAL ADAPTER FOR THE RX METER |
| 6 | SERVICE NOTES FOR THE RX METER TYPE 250A |
| 6 | SOME VHF BRIDGE APPLICATIONS |
| 10 | USE OF SMITH CHARTS FOR CONVERTING RX METER READINGS TO VSWR AND REFLECTION COEFFICIENT |
| 12 | LOW FREQUENCY ADJUSTMENT OF THE RX METER TYPE 250A |
| 16 | THE RX METER OR THE Q METER? |
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| 25 | CHECKING RX METER CALIBRATION |
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SECTION I

# TECHNICAL DATA

# AND

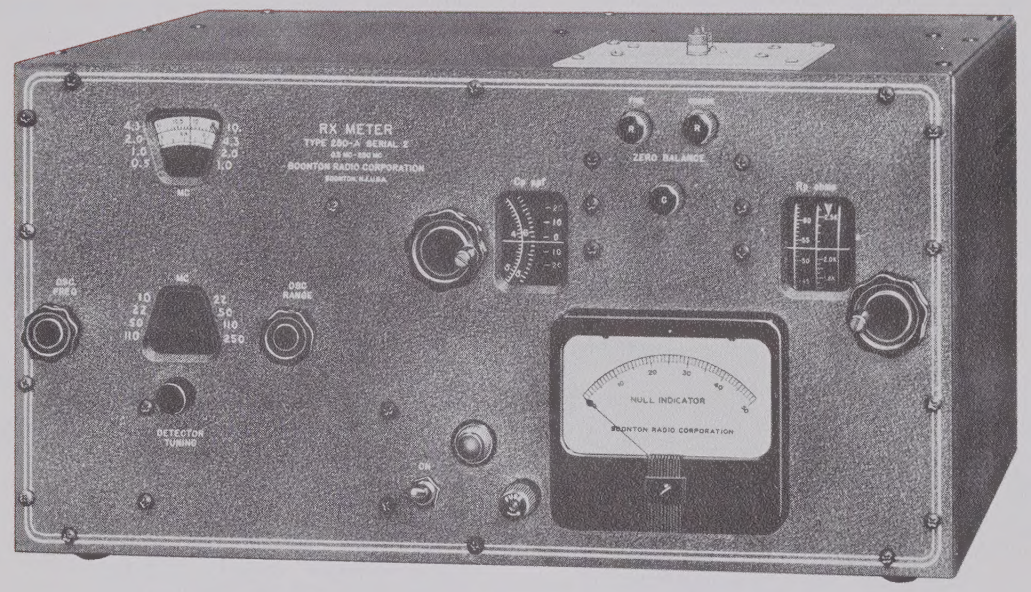
# SPECIFICATIONS

THE FOLLOWING TECHNICAL DATA SHEET CONTAINS THE PUBLISHED "CATALOG SPECIFICATIONS" TO WHICH EACH 250A RX METER IS GUARANTEED TO OPERATE WHEN IN GOOD REPAIR AND PROPERLY ALIGNED.

VOLTAGES AND OTHER TEST AND ALIGNMENT DATA GIVEN IN THIS MANUAL SHOULD NOT BE CONSIDERED AS "SPECIFICATIONS" OF THE INSTRUMENT BUT RATHER AS "TYPICAL LIMITS" WHICH WILL ASSURE OPERATION OF THE INSTRUMENT WITHIN "CATALOG SPECIFICATIONS".

# RX METER TYPE 250-A

FSN 6625-445-6902




*Frequency Range 0.5 to 250 MC*

## Description

The RX Meter Type 250-A is a completely self-contained instrument for use in measuring the equivalent parallel resistance and capacitance or inductance of two terminal networks. The instrument's design includes an accurate, continuously tuned oscillator, high frequency bridge, amplifier-detector, and null indicating meter.

The oscillator, which is carefully designed to minimize temperature effects, is mounted inside a rigid casting in order to obtain a high degree of accuracy, stability, and low leakage. A long life sub-miniature triode is used, and the unit is carefully shielded to avoid any leakage of signal to the amplifier-detector by any path other than through the bridge. The high frequency bridge is also mounted inside a casting, and is specially designed to minimize the effects of coupling between arms. All calibrated variable elements of the bridge are special low inductance high quality variable capacitors driven by anti-backlash gears. Connections to the unknown impedance are arranged for almost zero lead length. Convenient, easily adjusted bridge balance controls are available.

The amplifier-detector null indicator has high, automatically controlled gain and a very low noise level. The power supply is internally regulated.

## Features

The RX Meter is self-contained and requires no external units for its operation. This feature permits an integrated design and eliminates difficulties arising from leakage, hand effects, or improper matching which can occur when several different units must be interconnected in the laboratory. The instrument is always ready for use, and the assembly of several laboratory units is avoided.

**BOONTON RADIO COMPANY**

*A Division of Hewlett-Packard Company*

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*Precision Electronic Instruments since 1934*

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The range of measurement of equivalent parallel resistance, capacitance or inductance over the frequency range (0.5 to 250 mc.) is as follows: 15 to 100,000 ohms for parallel resistance (0 to 15 ohms by indirect methods); 0.1 to 120 pf for capacitance; and 0.001 microhenries to 100 millihenries for inductance. Resistance values are indicated directly, and no corrections are necessary over the entire frequency range. Small corrections at the higher frequencies, as indicated in the instruction book, are necessary in order to obtain the highest accuracy in the measurement of capacitance and inductance.

The capacitance dial is calibrated in 0.1 pf increments, and the resistance dial has good readability over a 28 inch scale length. The automatic gain control on the null indicator avoids meter damage and permits indication at all times of the correct direction for adjusting to balance. The low noise, high gain characteristics of the amplifier-detector result in high sensitivity near the balance point.

## Specifications

### Radio Frequency Characteristics

RF RANGE:
Total Range: 500 Kc. to 250 Mc.
No. Bands: 8

| Band Ranges: | | |
|---|---|---|
| | .5 — 1 Mc. | 9 — 21 Mc. |
| | 1 — 2 Mc. | 21 — 48 Mc. |
| | 2 — 4 Mc. | 48 — 110 Mc. |
| | 4 — 9 Mc. | 110 — 250 Mc. |

RF ACCURACY: ±1%.

RF CALIBRATION: Increments of approximately 1%.

### Resistance Measurement Characteristics

RESISTANCE RANGE: 15 to 100,000Ω.

RESISTANCE ACCURACY:

$$\pm \left[2 + \frac{F^*}{200} + \frac{R^*}{5000} + \frac{Q^*}{20}\right]\% \pm 0.2\Omega$$

*F = frequency (Mc); R = RX Meter $R_p$ reading (Ω); $Q = \omega CR \times 10^{-12}$, where C = RX Meter $C_p$ reading (pf)

RESISTANCE CALIBRATION: Increments of approximately 3% throughout most of range.

### Capacitance Measurement Characteristics

CAPACITANCE RANGE: 0 to 20 pf*
*May be extended through use of auxiliary coils.

CAPACITANCE ACCURACY:
$\pm$ (0.5 + 0.5 $F^2$ * C * $\times 10^{-5}$) % $\pm$ 0.15 pf
*F = frequency (Mc); C = RX Meter $C_p$ reading (pf).

CAPACITOR CALIBRATION: 0.1 pf increments.

### Inductance Measurement Characteristics

INDUCTANCE RANGE: 0.001 μh to 100 mh*
*Actual range depends upon frequency; auxiliary resistors employed.

INDUCTANCE ACCURACY: Basic accuracy is capacitance accuracy given above.

### Measurement Votage Level

RF: 0.05 to 0.75 Volts approximately*, depending upon frequency.
*May be reduced to 20 mv by installation of auxiliary potentiometer.

DC: 0.* volts.
*External DC current up to 50 ma. may be passed through RX Meter terminals.

### Accessories

FURNISHED: None.

AVAILABLE:
Type 515-A Co-Ax Adapter Kit (See below).

### Tube Complement

| | | |
|---|---|---|
| 1 — OD3 | 1 — 542-A | 2 — 6AG5 |
| 1 — 5Y3GT | 2 — 5718 | 1 — 6H-6 Ballast |

### Physical Characteristics

MOUNTING: Cabinet for bench use.

FINISH: Gray wrinkle, engraved panel (other finishes available on special order).

DIMENSIONS: Height: 10″ (25.4 cm); Width: 20″ (50.8 cm); Depth: 12″ (30.5 cm).

WEIGHT:
Net: 40 lbs. (18 kg)
Gross Domestic: 50 lbs. (22.5 kg)
Gross Export: 82 lbs. (36.9 kg)
Legal Export: 46 lbs. (20.7 kg)

### Power Requirements

250-A: 105-125 volts, 50-60 cps., 60 watts.

**Price: TYPE 250-A — $1695.00.**

# CO-AX ADAPTER KIT TYPE 515-A

Designed to permit connection to the RX Meter bridge circuit of any coaxial transmission line or fixture fitted with a type "N" male connector.

### SPECIFICATIONS

**A. ADAPTER**
1. Connector: Type "N" female
2. Characteristic impedance: 50 ohms
3. Finish: Silver plate with rhodium flash

**B. TERMINATION Type 516-A**
1. Connector: Type "N" male
2. Characteristic impedance: 50 ohms
3. DC Resistance: 50 ohms, ± 1%
4. Maximum parallel capacitance (mounted on adapter): ± 0.2 pf.
5. VSWR: Less than 1.10 up to 800 mc.
6. Maximum Power: ½ Watt

**Price: 515-A ADAPTER KIT $49.50**

## II TESTING OPERATION OF THE RX METER

This section is intended to outline the procedures for assuring proper operation of the instrument.

Subsection A gives "typical" operational characteristics as a general over-all test of the instrument's performance.

Subsection B presents procedures for testing the specified accuracies of the RX Meter.

### A. General Operational Check

Refer to Section II, Operation, of the Instruction Manual for the RX Meter Type 250A for operational procedures as required.

#### 1. Bridge Balance (.5 MC)

This is a test of the bridges ability to balance at its lowest frequency of operation.

(A) Switch OSC RANGE Control to .5 MC - 1 MC range; set OSC FREQ Control to .5 MC.

(B) Short circuit HI and LO terminal posts; pointer on NULL INDICATOR should be above 35 divisions.

(C) Open circuit HI and LO terminal posts.

(D) Following conventional RX Meter operation procedures, see that the bridge will balance.

NOTE: If a balance cannot be obtained at .5 MC, C109 adjustment may have been disturbed. Extreme care must be taken in its readjustment to avoid having another Rp dial marked and engraved. Refer to instructions on page 25 .

#### 2. Range of C-Balance Control (.5 MC)

This test is to see that the range of capacitance change of the string-driven vane capacitor, C107, is sufficient to obtain bridge balance under all conditions.

(A) Using conventional RX Meter procedures, peak and then null the bridge. Use .5 MC frequency with Rp at $\infty$ and Cp at zero.

(B) Turn C-Balance Control full clockwise (vane pulled farthest from top plate.)

(C) Rebalance bridge using Cp Control, only; the Cp reading will usually be more negative than -1.5$\mu\mu$F.

NOTE: Should balance occur at a Cp setting more positive than -1.5$\mu\mu$F, no corrective action need be attempted unless it is impossible to balance the bridge because of insufficient clockwise C-Balance range. This is a check of "typical" operation, only.

(D) Turn C-Balance Control full counterclockwise (vane against mica on bottom side of top plate).

(E) Rebalance bridge using Cp Control, only; the Cp reading should be more positibe than +7.5μμF (+20μμF or greater is not uncommon).

NOTE: If +7.5μμF cannot be attained, it will be necessary to increase capacity between vane and top-plate. Vane should be flat against mica; lengthen string and/or slightly reform vane as required. If vane is already against mica, separate mica to leave a thinner piece on the top plate. To replace the mica (BRC #302602) affix it to the top plate using regular coil dope; split mica for required thickness.

3. Null Sensitivity (.5 MC)

This test checks the nulling sensitivity by unbalancing the bridge a pre-determined amount, and observing the amplified unbalanced signal on the NULL INDICATOR.

(A) With frequency at .5 MC, balance bridge using conventional RX Meter operation procedures.

(B) Decrease Rp dial from ∞ to 100 K; the NULL INDICATOR pointer should raise to about 6 to 10 scale divisions.

(C) If indication is above the nominal 6-10 divisions, T201 and/or T202 in the IF Amplifier may be slightly detuned. (Do not adjust the center can, L201; it determines IF frequency). This detuning is recommended only if sensitivity is so great it causes irratic null indications, especially on the 4-9 MC range.

(D) An indication lower than the nominal 6-10 divisions could be caused by:

(1) Low RF Output from Oscillator(s)

(2) Fault in V101 stage

(3) Fault in IF Amplifier and metering circuit

4. Tracking of Oscillators (4-9 MC Range)

This test determines if the tuning capacitor (C321) in the Detector Oscillator is tracking with respect to the tuning capacitor (C305) in the Signal Oscillator.

(A) Switch OSC RANGE Switch to 4-9 MC range; set OSC FREQ Control for 9.0 MC on dial.

(B) Short HI and LO terminal posts with a short piece of wire.

(C) Adjust DETECTOR TUNING Control for a peak indication on the NULL INDICATOR (above 35 scale divisions). There will be two peaks; choose the one most CCW on the DETECTOR TUNING Control. This "first peak" will normally occur at mid-range on the DETECTOR TUNING Control (approximately 12 turns from maximum CW or CCW rotation).

(D) Rotate OSC FREQ Control slowly from 9.0 to 4.0 MC; the meter pointer should remain within approximately a 5 scale division area. Above 9.0 MC and below 4.0 MC variations usually will be greater.

NOTE: If pointer varies MORE than 5 divisions, do NOT take this as an indication of trouble within the Oscillator Assembly. The 5 division variation is characteristic of an instrument where the Detector Oscillator has been PRECISELY tracked at 105 KC ABOVE the Signal Oscillator. If realignment of the oscillator(s) is required, this criterion should be met, but during normal operation of the RX Meter, the only requirement is that the DETECTOR TUNING Control "peak" at all frequencies on all bands (exception: the .5-1.0 MC range may not "peak" at all frequencies, but should indicate above 35 scale divisions on the NULL INDICATOR).

5. Tracking of Oscillators (110-250 MC Range)

This is a test of Oscillator Tracking on the most critical range.

(A) Switch OSC RANGE Control to 110-250 MC range; set OSC FREQ Control to 250 MC.

(B) Short HI and LO terminal posts with a piece of wire.

(C) Adjust DETECTOR TUNING Control for a peak indication on the NULL INDICATOR. There are two peaks relatively close together; choose the one most CCW ("first peak").

(D) Change the oscillator frequency in convenient increments across the band, checking the ability to re-peak at each frequency. Adjustment of the DETECTOR TUNING Control WILL be required, but tuning should remain within its range. Make SURE you are tracking to the "first peak", as discussed in (C) above, since the "second peak" normally does not remain within range of the DETECTOR TUNING Control.

NOTE: Shifting of the peak with movement of OSC RANGE Control is normal, as long as re-peaking with the DETECTOR TUNING Control is possible.

## 6. RF Leakage

There are a couple of simple checks that can be made to determine if RF Leakage from the Oscillator Assembly is low enough so as not to impair nulling of the bridge; either or both may be used.

### Method #1

(A) Set Rp to ∞, Cp to zero.

(B) Set OSC RANGE Control to 110-250 MC range and adjust frequency to exactly 110 MC with OSC FREQ Control. Measure frequency at HI and LO terminals with an electronic counter or crystal calibrator.

(C) Using conventional RX Meter techniques, null the bridge.

(D) Turn OSC RANGE Control to 48-110 MC band and readjust frequency to exactly 110 MC (as measured externally) with OSC FREQ Control.

(E) Short HI and LO terminal posts and re-peak with DETECTOR TUNING Control. (Do not move R-Balance or C-Balance Controls).

(F) Upon removing the short from the terminals, the bridge should still be in balance as it was before. If there is RF Leakage, it will be necessary to rotate the zero balance controls to restore balance.

### Method #2

(A) Set Rp to ∞ , Cp to zero.

(B) Set OSC RANGE Control to 110-250 MC range, and OSC FREQ Control to approximately 250 MC.

(C) Using conventional RX Meter techniques, null the bridge (adjust C101 bridge trimmer, if required).

(D) With top cover of instrument removed, place hand near gears at rear of oscillator casting, where shaft enters Signal Oscillator.

(E) With hand in place (mentioned in (D) above), if the NULL INDICATOR rises from a null to above 10 scale divisions RF Leakage should be considered excessive.

NOTE: If excessive RF Leakage DOES exist, use a small loop antenna and a receiver to locate the source of leakage. Cap the Signal Oscillator RF output jack tightly. Remove B+ from the Detector Oscillator (at top of RF filter) to prevent confusion; Signal Oscillator leakage is of primary interest.

* ALL SCREWS MUST BE TIGHT OR NO NULL AT FREQ'S ON 110-250 RANGE - CHECK DETECTOR HOUSING AND OSCILLATOR HOUSING CAREFULLY. 1 SCREW MISSING CAN KEEP UNIT FROM NULLING AT ALL

## 7. Bridge Balance (110-250 Range)

This test checks the balance of the bridge circuitry on the most critical range. Proper indications here assure that the bridge will balance on all other frequency ranges.

(A) Following conventional RX Meter operation procedures, see that the bridge will balance at 250 MC. (Refer to BRIDGE TRIMMER ADJUSTMENT, page 16 of the RX Meter Instruction Manual, if unable to balance bridge; adjust C101 as appropriate).

(B) Rebalance the bridge at 225 MC, 200 MC, 170 MC, 150 MC and 110 MC; balance at these (or any other) frequencies should be within the range of the front panel balance controls. Notice that it will be necessary to re-peak DETECTOR TUNING Control each time frequency is changed.

## B. Testing Specified Accuracies

### 1. RF (Frequency) Accuracy

Using an Electronic Counter, Frequency Meter, or Crystal Calibrator connected between HI and LO terminal posts, the accuracy of the Signal Oscillator may be checked. Approximately 100 to 700 millivolts are available for measurement, depending upon frequency.
Specification: ±1% of dial reading.

### 2. Rp (Resistance) Accuracy

The following procedure tests the resistance measurement accuracy at selected increments across the Rp dial by measuring components of known characteristics and accuracy.

(A) Make the following measurements at .5 MC (do not use higher frequencies).

(B) Measure the resistance, as indicated on the Rp dial, of precision 1/2% 200Ω, 3KΩ and 10KΩ resistors.

NOTE: Use "DALOHM" type DCH-$\frac{1}{2}$ high frequency deposited carbon, hermetically sealed resistors, or equivalent.

(C) The Rp accuracy is specified by the formula:

$$\pm\left(2 + \frac{f}{200} + \frac{Rp}{5000} + \frac{Q}{20}\right)\% \pm 0.2\Omega$$

For this test the equation may be simplified to:

±2% at 200Ω
±2.6% at 3KΩ
±4% at 10KΩ

Since 200Ω, 3KΩ and 10KΩ are among the factory dial calibration points, accuracy will normally be considerably better than specifications.

(D) THIS "SPOT-CHECK" AT THE ABOVE CARDINAL POINTS OF THE RP DIAL IS SUFFICIENT TO ASSURE PROPER CALIBRATION. ADDITIONAL VALUES OF EQUIVALENT RESISTORS MAY BE TESTED IF DESIRED.

3. CP (CAPACITANCE) ACCURACY*

THE CP CAPACITOR, C111, IS TESTED BY COMPARING ITS INCREMENTAL CHANGE OF CAPACITANCE WITH THAT OF A STANDARD VARIABLE CAPACITOR OF GREATER ACCURACY. ABSOLUTE CAPACITANCE IS NOT MEASURED BECAUSE ALL CP MEASUREMENTS ARE CHANGES OF CAPACITANCE REFERENCED TO THE VALUE OF CP WHEN THE BRIDGE IS INITIALLY BALANCED.

A TOTAL CHANGE OF CAPACITANCE OF 120μμF IS TO BE MEASURED, SINCE THE CP CAPACITOR IS AT MINIMUM ABSOLUTE CAPACITANCE WHEN THE DIAL IS AT +20μμF, AND AT MAXIMUM WHEN THE DIAL IS AT -100μμF.

BRIDGE BALANCE IS USED AS AN INDICATION OF EQUAL AND OPPOSITE INCREMENTAL CHANGES IN CAPACITANCE OF CP AND THE STANDARD; IF THE STANDARD CAPACITOR IS REDUCED EXACTLY 10μμF THE CP SETTING MUST BE INCREASED EXACTLY THE SAME AMOUNT TO RE-NULL THE RX METER BRIDGE. IN THIS WAY, THE ACCURACY OF THE CP CAPACITOR IS COMPARED WITH THAT OF THE EXTERNAL STANDARD.

THE RX METER IS INITIALLY BALANCED AT $R_P = \infty$ AND $C_P = 0.00$ WITH NO EXTERNAL CONNECTIONS TO THE HI TERMINAL POST. TO RETAIN BRIDGE BALANCE WHEN THE STANDARD CAPACITOR IS CONNECTED, A SHIELDED INDUCTOR IS ALSO CONNECTED IN PARALLEL. THE VALUE OF INDUCTANCE IS CHOSEN TO RESONATE WITH THE CAPACITIVE REACTANCE OF THE STANDARD PLUS THAT OF ALL INTER-CONNECTING CONDUCTORS. (SEE RECOMMENDED VALUES IN CHART ON NEXT PAGE).

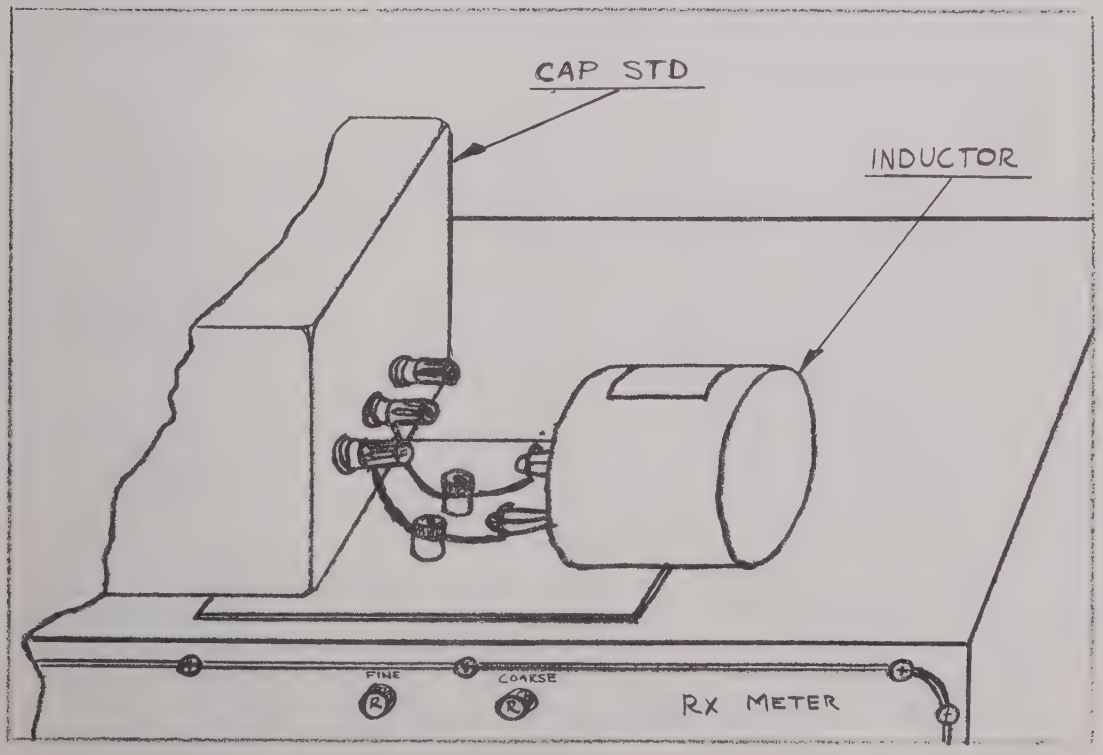
POSITION THE STANDARD CAPACITOR AND INDUCTOR ON TOP OF THE RX METER SO SHORT CONNECTIONS WITH LARGE CONDUCTORS CAN BE MADE (MINIMUM POSSIBLE LEAD INDUCTANCE). EXCESSIVE INDUCTIVE REACTANCE IN SERIES WITH THE STANDARD CAPACITOR WILL REDUCE ITS "EFFECTIVE" CAPACITANCE RESULTING IN A FALSE INDICATION OF ERROR IN THE CP CALIBRATION. THIS PROCEDURE USES A FREQUENCY OF APPROXIMATELY .5MC WHERE THE INDUCTANCE OF SHORT, LARGE CONDUCTORS WILL BE NEGLIGIBLE. WHEN MAKING CONNECTIONS NOTICE THAT THE RX METER, THE STANDARD CAPACITOR AND THE SHIELDED COIL EACH HAVE A HIGH POTENTIAL AND GROUND (OR SHIELD) SIDE.

* FOR AN ALTERNATE PROCEDURE REFER TO BRC NOTEBOOK #7, PAGE 7. TO USE THE TECHNIQUE DESCRIBED THEREIN SUBSTITUTE THE RX METER FOR "Q METER TO BE CALIBRATED". R106, R108 AND R110 MUST BE UNSOLDERED FROM THE CP STATOR TO PREVENT Q CIRCUIT LOADING.

THE "STANDARD" PRECISION CAPACITOR USED SHOULD HAVE AN ACCURACY GREATER THAN THAT SPECIFIED FOR THE RX METER AT .5MC, WHICH IS ±(.5% + .15μμF). THE LOW SECTION OF THE GR 1422D IS USED IN THIS PROCEDURE (ACCURACY: ±.1PF, 35PF TO 115PF). SINCE ITS TOTAL RANGE IS LESS THAN THE 120μμF REQUIRED A SECOND "REFERENCE" IS ESTABLISHED IN THE FOLLOWING STEP (H).

THE FOLLOWING INDUCTORS ARE RECOMMENDED WHEN USING THE GR 1422D STANDARD CAPACITOR; OTHERS MAY BE USED DEPENDING UPON THE STANDARD CAPACITOR AVAILABLE TO YOU.

| To Measure Cp Range | Start Measurement with Cp at | Start Measurement with Std. at | Approx. Inductance Required | BRC Inductor Type |
|---|---|---|---|---|
| +20 to -60 | 0.00 | 95.00 | 1MH | 103-A31 |
| -60 to -100 | -60.00 | 115.00 | 500μH | 103-A25 |



MEASUREMENT PROCEDURE:

(A) CONNECT EQUIPMENT AS DESCRIBED ON PAGE 12 . USE SHORT, LARGE CONDUCTORS.

(B) SET OSC RANGE SWITCH TO .5-1 MC; OSC FREQ CONTROL TO APPROXIMATELY .5 MC.

(C) TEMPORARILY REMOVE EXTERNAL CONNECTIONS FROM HI TERMINAL POST AND BALANCE THE BRIDGE ($C_P = 0$; $R_P = \infty$).

(D) RECONNECT EXTERNAL CONNECTIONS TO HI TERMINAL.

(E) SET STANDARD CAPACITOR TO VALUE SHOWN ON CHART A FOR "REFERENCE #1". ($C_P$ SHOULD BE AT 0.00).

(F) SUCCESSIVELY ADJUST OSC FREQ AND $R_P$ CONTROLS FOR SHARPEST NULL ON NULL INDICATOR.

(G) INCREASE STANDARD CAPACITOR SETTINGS IN INCREMENTS OF EXACTLY 10.00μμF TO MEASURE $C_P$ FROM 0 TO ±20, THEN DECREASE TO MEASURE FROM 0 TO-60. SEE CHART A "REFERENCE #1" FOR SETTINGS AND SPECIFIED RX METER TOLERANCES. USE $R_P$ AND $C_P$ CONTROLS (ONLY) AS REQUIRED TO OBTAIN THE SHARPEST NULL.

RECOMMENDED TECHNIQUE: CHANGE STANDARD CAPACITOR BY 10μμF, THEN RE-NULL USING $C_P$ AND $R_P$ CONTROLS. IF NULL APPEARS BROAD, APPROACH NULL SEVERAL TIMES IN BOTH DIRECTIONS AND TAKE AN AVERAGE $C_P$ READING AS EXACT NULL.

(H) AFTER MEASUREMENT OF $C_P = -60$, SET $C_P$ TO EXACTLY $C_P = -60.00$ AND STANDARD CAPACITOR TO VALUE SHOWN ON CHART A FOR "REFERENCE #2".

(I) SUCCESSIVELY ADJUST OSC FREQ AND $R_P$ CONTROLS FOR SHARPEST NULL ON NULL INDICATOR. THIS ESTABLISHES $C_P = -60.00$ AS AN "ERRORLESS" REFERENCE POINT FOR FURTHER MEASUREMENTS.

(J) DECREASE STANDARD CAPACITOR SETTINGS IN INCREMENTS OF EXACTLY 10.00μμF TO MEASURE $C_P$ FROM -60 TO -100. SEE CHART A FOR "REFERENCE #2" SETTINGS AND SPECIFIED TOLERANCES.

NOTE: "REFERENCE #2" TOLERANCES GIVEN ON CHART A TAKE INTO ACCOUNT THAT -60 WAS ESTABLISHED AS AN "ERRORLESS" REFERENCE POINT. IF THE TOTAL RANGE OF YOUR PARTICULAR STANDARD CAPACITOR IS 120μμF OR GREATER (WHILE HAVING THE REQUIRED ACCURACIES), AND YOU CHOOSE NOT TO RE-ESTABLISH REFERENCE AT -60μμF, THE "REFERENCE #1" TOLERANCES GIVEN ON CHART A MUST BE USED.

## CHART A

| Cp Setting (μμF) | Standard Capacitor Setting (μμF) | Total Cp Tolerance at .5 MC (±.5% +.15μμF) |
|---|---|---|
| +20 | 115.00 | ±.25 |
| +10 | 105.00 | ±.20 |
| 0.00 | 95.00 | (Reference #1) |
| -10 | 85.00 | ±.20 |
| -20 | 75.00 | ±.25 |
| -30 | 65.00 | ±.30 |
| -40 | 55.00 | ±.35 |
| -50 | 45.00 | ±.40 |
| -60 | 35.00 | ±.45 |
| -70 | - | ±.50 |
| -80 | - | ±.55 |
| -90 | - | ±.60 |
| -100 | - | ±.65 |
| -60 | 115.00 | (Reference #2) |
| -70 | 105.00 | ±.20 |
| -80 | 95.00 | ±.25 |
| -90 | 85.00 | ±.30 |
| -100 | 75.00 | ±.35 |

## I TEST AND ALIGNMENT PROCEDURES

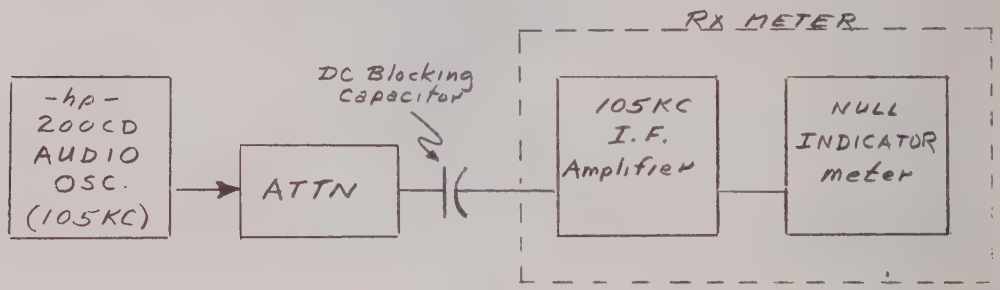
### A. Power Supply Tests

1. Measure the regulated filament voltage at C314, 2µF capacitor on top of the oscillator filters (usually yellow/black wire). The voltage should be nominally 6.3 volts AC.

2. Measure B+ voltage at C315, .25µF on top of the oscillator filters (usually red/white wire). The voltage should be approximately +150 volts DC.

### B. IF Amplifier and Metering Circuit Test & Alignment

1. To align the IF Amplifier connect equipment as follows:




When connecting the attenuator to the IF Amplifier, observe that B+ voltage appears at the center pin of P203; use a DC blocking capacitor, as required.

2. Adjust T201 (top and bottom), L201 (top-no slug on bottom) and T202 (top and bottom) for maximum indication on NULL INDICATOR Meter. Set attenuator as required to keep the indication around 10-15 divisions. Higher indications will cause the AGC to obscure the adjustments.

   Notice that T201 and T202 are extremely broad in their adjustment, whereas L201 is quite sharp. As a final step, assure that L201 is peaked at 105 KC.

3. To determine if the IF Amplifier is functioning properly make the test "Check Null Sensitivity" on page 8.

### C. Oscillator Alignment

1. Mechanical check of oscillator before alignment (Oscillator removed from Front Panel)

   (a) See that hair line on fiducial lines up and is parallel with the scribe marks at the extreme ends of dial travel; position fiducial as required. Over-run at both full CW and full CCW positions should be approximately equal.

(B) WITH SIDE PLATE REMOVED FROM LEFT SIDE OF OSCILLATOR ASSEMBLY INSPECT RELATIVE POSITION OF ROTORS AND STATORS IN BOTH OSCILLATORS. THE TOP OUTSIDE CORNERS OF THE ROTOR PLATES SHOULD BE JUST EVEN WITH THE TOP EDGE OF OF THE STATOR PLATES WHEN THE SCRIBE MARK ON THE DIAL LINES UP WITH THE FIDUCIAL.

(C) REPOSITION DRIVE GEARS, STOPS DIAL, ETC. TO MEET REQUIREMENTS OF (A) AND (B) ABOVE. BE SURE THAT BOTH ROTORS ARE TRACKING TOGETHER, AND THAT THE BEARINGS RUN SMOOTHLY WITH NO CATCHES OR HEAVY SPOTS.

(D) OBSERVE PLATE SPACING OF BOTH CAPACITORS; ROTOR AND STATOR PLATES SHOULD BE EVENLY SPACED.

(E) CHECK WIRING OF TUBES. SEE THAT THERE ARE NO SHORT CIRCUITS. LEADS SHOULD HAVE BEEN CUT OFF AS SHORT AS PRACTICAL BEFORE BEING SOLDERED. PIN #6 SHOULD BE ADJACENT TO GROUND LUG TO WHICH IT IS SOLDERED. (NOTICE THAT LEADS #'S 2, 4 AND 7 ARE CLIPPED OFF AT THE ENVELOPE).

(F) SEE THAT ALL (10) SET SCREWS ON GEAR TRAIN ARE TIGHT.

(G) SEE THAT DETECTOR TUNING CONTROL OPERATES SMOOTHLY AND DOES NOT BIND.

(H) OBSERVE THE CLIP-CONTACTS THAT MATE WITH PIN-CONTACTS ON REVOLVING TURRETS (3 SETS OF 2 FOR EACH TURRET). THE TURRET PINS SHOULD FIRST CONTACT IN THE CENTER OF THE CLIPS AND COME TO REST AT THEIR MID-POINTS WHEN THE TURRET IS IN DETENT. THE CLIPS USUALLY HAVE SUFFICIENT TENSION TO CLOSE COMPLETELY WHEN THE PIN IS NOT BETWEEN THEM (EXCEPT FOR OUTPUT COIL CONTACTS).

(I) WITH A VTVM (-HP-410B OR EQUIVALENT) MEASURE THE GRID VOLTAGE OF BOTH OSCILLATORS ON EACH FREQUENCY RANGE. AT THE LOWEST POINT ACROSS THE BAND, THE VOLTAGE, WILL USUALLY BE 4 VOLTS OR GREATER ON THE TWO HIGHEST FREQUENCY RANGES, AND 10 VOLTS OR GREATER ON THE OTHERS.

(J) THE CORES IN THE COILS FOR THE 9-21 MC, 21-48 MC AND 48-110 MC RANGES ARE HELD IN PLACE WITH AMPHENOL COIL DOPE "912". LOOSEN WITH AMPHENOL THINNER "916" OR EQUIVALENT TO AVOID BREAKING CERAMIC COIL FORM.

NOTE: IN ADJUSTING THE SLUGS IN THE COILS OF BOTH THE SIGNAL AND DETECTOR OSCILLATORS THOSE FOR THE .5-1 MC, 1-2 MC, 2-4 MC AND 4-9 MC RANGES SHOULD BE ADJUSTED TOWARD THE OUTSIDE OF THE CASTING (TOWARD REAR OF INSTRUMENT FOR SIGNAL OSCILLATOR; TOWARD FRONT OF INSTRUMENT FOR DETECTOR OSCILLATOR).

THE POWDERED IRON CORES FOR THE 9-21 MC RANGE AND THE BRASS CORES FOR THE 21-48 MC AND 48-110 MC RANGES SHOULD BE ADJUSTED TOWARD THE CENTER OF THE CASTING (TOWARD FRONT OF INSTRUMENT FOR SIGNAL OSCILLATOR; REAR OF INSTRUMENT FOR DETECTOR OSCILLATOR).

THERE ARE TWO POSITIONS OF EACH CORE THAT WILL RESULT IN THE SAME OUTPUT FREQUENCY UNLESS THE FINAL ADJUSTMENT RESTS AT THE ELECTRICAL CENTER OF THE COIL. IF THE ABOVE RULE IS NOT FOLLOWED AND THE CORES ARE ADJUSTED TO THE WRONG POSITION, REDUCED RF OUTPUT, INTERFERENCE, OR BOTH MAY RESULT.

2. SIGNAL OSCILLATOR PRELIMINARY ADJUSTMENTS

(A) REMOVE B+ CONNECTIONS FROM DETECTOR OSCILLATOR AT FRONT FILTER ON TOP OF OSCILLATOR ASSEMBLY. THIS DISABLES THAT OSCILLATOR ELIMINATING THE POSSIBILITY OF BEAT NOTES, ETC. WHILE TRACKING THE SIGNAL OSCILLATOR.

(B) REMOVE BOTH THE LARGE AND SMALL SCREW PLUGS FROM THE REAR OF OSCILLATOR CASTING FOR ACCESS TO COIL ADJUSTMENTS. (LEFT SIDE PLATE SHOULD BE REMOVED, IF NOT ALREADY DONE).

(C) ADJUST TRIMMER CAPACITOR C304 (ON REAR OF CASTING) SO LARGE PORTION OF SLUG IS ABOUT HALF WAY IN RING ON TIP OF GLASS TUBE.

(D) CONNECT ELECTRONIC COUNTER OR CRYSTAL CALIBRATOR TO TERMINAL POSTS ON TOP OF BRIDGE (FROM .1 TO .7 VOLTS WILL BE AVAILABLE FOR MEASUREMENT, DEPENDING UPON FREQUENCY).

3. SIGNAL OSCILLATOR ALIGNMENT

(A) 4-9 MC RANGE TRACKING (SIGNAL OSCILLATOR)

THE ACCURACY WITH WHICH THIS RANGE IS TRACKED, BY BENDING SERRATED PLATES OF C305, WILL DETERMINE THE OVER-ALL FREQUENCY DIAL ACCURACY AFTER COMPLETE ALIGNMENT (CARE IN ADJUSTMENT HERE WILL PAY OFF LATER).

(1) SET OSC RANGE SWITCH TO 4-9 MC RANGE; OSC FREQ CONTROL FOR 9.0 MC ON DIAL.

(2) TUNE COIL SLUG FOR EXACTLY 9.0 MC AS MEASURED EXTERNALLY.

(3) DECREASE FREQUENCY IN INCREMENTAL STEPS BENDING EACH SERRATED PLATE ON C305 TO TRACK OUTPUT FREQUENCY TO DIAL CALIBRATIONS.

(B) 110-250 MC RANGE ALIGNMENT (SIGNAL OSCILLATOR)

THE FREQUENCY OF THE 110-250 MC RANGE IS ADJUSTED BY CHANGING THE "TABS" (INDUCTANCE) AT THE LOW FREQUENCIES, AND THE ALL-BAND TRIMMER CAPACITOR, C304, AT THE HIGH FREQUENCIES.

THE "TABS" ARE ON THE TURRET JUST BELOW THE PIN CONTACTS. ONE IS ON EACH SIDE OF THE TURRET WITH A BAR PASSING THRU THE EDGE OF THE TURRET TO CONNECT THEM. (ONLY THIS RANGE HAS THE CONNECTING BAR AND "TABS", SO IS EASY TO IDENTIFY VISUALLY).

To increase the output frequency the "tabs" must be moved closer together (decrease inductance); to decrease the output frequency move them apart (more inductance). The amount of solder on the "tabs" will also affect the inductance; add more solder to increase inductance and lower frequency (and vice versa).

To move the "tabs" heat with a soldering iron and when solder melts move them with a small screwdriver or other appropriate tool. Allow solder to cool.

The side cover will affect the frequency of this range. Momentarily replace it when measuring output frequency.

If, after adjusting "tabs", the frequency does not track to the dial calibration (within the specified tolerance) the trimmer capacitor, C304, may be adjusted at the high frequency end of the range. If C304 is adjusted return to the 4-9 MC range and check the high end of that band; it will have shifted slightly.

NOTE: The "tabs" are a fine adjustment of inductance; if a coarse adjustment is required, change the length of the STRAP that is soldered to the rear contact of the STATOR of the variable capacitor (shorten strap to decrease inductance). It should be approximately the same shape and length in both the oscillators.

(c) .5-1 MC Range Alignment (Signal Oscillator)

(1) Set OSC RANGE Switch to .5-1 MC range; OSC FREQ Control to .5 MC on dial.

(2) Tune coil slug for exactly .5 MC, as measured externally.

(3) Set OSC FREQ Control for 1 MC on dial and adjust trimmer capacitor. Access is thru hole on rear of casting.

(4) Optimize above adjustments so all frequencies across the band are within specifications.

(d) 1-2 MC Range Alignment (Signal Oscillator)

Procedure is same as for .5-1 MC range. Adjust slug at 1 MC, trimmer at 2 MC.

(e) 2-4 MC Range Alignment (Signal Oscillator)

Procedure is same as for .5-1 MC range. Adjust slug at 2 MC, trimmer at 4 MC.

(f) 4-9 MC Range (Signal Oscillator)

(This range was aligned in step (a) and should not be repeated here. All other ranges are adjused with reference 4-9 MC range settings).

(G) 9-21 MC RANGE ALIGNMENT (SIGNAL OSCILLATOR)

NOTE: THE COIL FORM OF THIS RANGE IS MADE OF CERAMIC AND THE POWERED IRON CORE IS HELD IN PLACE WITH AMPHENOL COIL DOPE "912". LOOSEN USING AMPHENOL THINNER "916" OR EQUIVALENT BEFORE ATTEMPTING TO TURN SLUG. IF EITHER SLUG OR COIL FORM IS BROKEN, THE OSCILLATOR COIL MUST BE REPLACED. (THIS ALSO APPLIES TO THE NEXT TWO HIGHER FREQUENCY RANGES, EXCEPT THEIR SLUGS ARE BRASS).

(1) LOOSEN COIL DOPE WITH THINNER SO SLUG TURNS FREELY.

(2) ADJUST SLUG TO A POSITION WHERE ALL FREQUENCIES ACROSS THE BAND ARE WITHIN TOLERANCE. SEE NOTE ON PAGES 17 AND 18 CONCERNING FINAL POSITION OF SLUG.

(3) NOTE EXACT FREQUENCY AT ANY PARTICULAR POINT OF THE DIAL, THEN BACK SLUG OUT OF COIL SO A FEW THREADS ARE EXPOSED. APPLY A SMALL AMOUNT OF COIL DOPE (AMPHENOL "912" OR EQUIVALENT) AND RESET SLUG FOR FREQUENCY PREVIOUSLY NOTED.

(4) RECHECK FREQUENCY ACROSS THE BAND SO ANY SLIGHT ADJUSTMENT MAY BE MADE BEFORE COIL DOPE SETS-UP.

(H) 21-48 MC RANGE ALIGNMENT (SIGNAL OSCILLATOR)

PROCEDURE IS THE SAME AS FOR 9-21 MC RANGE. AT FINAL ADJUSTMENT SLUG WILL USUALLY EXTEND APPROXIMATELY 1/8" OUT OF COIL FORM TOWARD CENTER OF CASTING. BE-SURE TO LOOSEN SLUG WITH THINNER BEFORE ATTEMPTING TO TURN, AND RE-DOPE SLUG AFTER FINAL ALIGNMENT.

(I) 48-110 MC RANGE ALIGNMENT (SIGNAL OSCILLATOR)

PROCEDURE IS THE SAME AS FOR 9-21 MC RANGE. SLUG POSITION IS SIMILAR TO 21-48 MC RANGE. BE SURE TO LOOSEN AND THEN RE-DOPE SLUG.

(J) 110-250 MC RANGE (SIGNAL OSCILLATOR)

THIS RANGE WAS ADJUSTED IN STEP (B) AND NEEDS ONLY TO BE RECHECKED AT THIS TIME. KEEP IN MIND THAT IF THE TRIMMER, C304, IS READJUSTED IT ALSO AFFECTS THE HIGH FREQUENCY END OF OTHER RANGES (BUT TO A SMALLER DEGREE).

(K) REPLACE SCREW PLUGS IN BACK OF CASTING; RECONNECT B+ TO DETECTOR OSCILLATOR.

4. DETECTOR OSCILLATOR PRELIMINARY ADJUSTMENTS

NOTE: BEFORE ATTEMPTING TO ADJUST THE DETECTOR OSCILLATOR BE SURE THAT THE IF AMPLIFIER IS TUNED TO 105 KC (SEE SECION III-B).

(A) REMOVE DIAL-MASK AND FIDUCIAL.

(B) MAKE A SCRATCH MARK ACROSS DIAL HUB ONTO DIAL SUCH THAT DIAL CAN BE REMOVED AND REPLACED WITHOUT CHANGING ITS POSITION ON THE HUB.

(c) Remove dial and then large nut and smaller screw in casting for access to adjustments within Detector Oscillator.

(d) To assure bridge unbalance while tracking Detector Oscillator to Signal Oscillator, short HI and LO posts together with a short piece of wire.

5. Detector Oscillator Alignment

(a) 4-9 MC Range Tracking (Detector Oscillator)

The accuracy with which this range is tracked, by bending serrated plates of C321, will determine the over-all ability of the DETECTOR TUNING Control to adjust the difference frequency to exactly 105 KC at all frequencies on all bands (care in adjustment and tracking of C321 will pay off later).

(1) Set DETECTOR TUNING Control mid-range (approximately 12 turns from either extreme).

(2) Set OSC FREQ Control such that tuning capacitor, C321, has only the first small serrated plate in mesh with stator.

(3) Adjust slug in coil for a peak on the NULL INDICATOR. There will be two peaks; choose the first peak when turning slug in a clockwise direction.

(4) Decrease frequency in incremental steps, bending serrated plates as required to maintain the peak on the NULL INDICATOR as the frequency is changed across the band.

(5) Slowly change frequency across the band; the pointer should remain within a range of less than 5 scale divisions. It may, however, vary more than that when the Signal Oscillator is below 4 MC or above 9 MC (dial is off, so measure frequency at HI terminal post, if required).

(b) 110-250 MC Range Tracking (Detector Oscillator)

(1) Set OSC RANGE Switch to 110-250 MC range.

(2) Turn OSC FREQ Control such that the tuning capacitor, C321, has only the first small serrated plate in mesh with the stator.

(3) Adjust DETECTOR TUNING Control for a peak on the NULL INDICATOR. There will be <u>two</u> peaks; choose the one furthest CCW on the DETECTOR TUNING Control.

(4) Simultaneously adjust the OSC. FREQ and DETECTOR TUNING Controls as the frequency is changed across the band; retain the peak on the NULL INDICATOR as the frequency is changed. The peak should remain within the range of the DETECTOR TUNING Control across the frequency band.

NOTE: Replacing side plate will cause DETECTOR TUNING Control to peak at 1 or 2 turns further CCW than when it is off.

(5) If DETECTOR TUNING Control runs out of range:

Insufficient CCW range--move "tabs" on turret closer together (less inductance); see 3-(B), page 18 for location of and techniques for adjustment of "tabs".

Insufficient CW range--as in above paragraph, except move "tabs" further apart, or lengthen strap on stator.

(c) .5-1 MC Range Tracking (Detector Oscillator)

(1) Set OSC RANGE Switch to .5-1 MC range; OSC FREQ Control for near full mesh of variable tuning capacitor.

(2) Turn DETECTOR TUNING Control full CCW, then 2 turns CW.

(3) Adjust slug in coil for peak on NULL INDICATOR. See NOTE after paragraph C-1-(J) on page 17 .

(4) Set OSC FREQ Control such that only the first small serrated plate is in mesh; adjust trimmer capacitor for peak on NULL INDICATOR (access is thru small hole in front side of casting).

(5) Change OSC FREQ Control across band, re-peaking with DETECTOR TUNING Control. The indication should be above 35 scale divisions on NULL INDICATOR, even if it does not "peak" at all frequencies.

(6) Repeat above steps to obtain optimum tracking, as required.

(D) 1-2 MC Range Tracking (Detector Oscillator)

Procedure is same as for .5-1 MC range.

(E) 2-4 MC Range Tracking (Detector Oscillator)

Procedure is same as for .5-1 MC range, EXCEPT set DETECTOR TUNING Control approximately mid-range (12 turns from either extreme).

(F) 4-9 MC RANGE TRACKING (DETECTOR OSCILLATOR)

(THIS RANGE WAS PREVIOUSLY ADJUSTED IN STEP 5-(A) AND NEED NOT BE REPEATED HERE).

(G) 9-21 MC RANGE TRACKING (DETECTOR OSCILLATOR)

(1) LOOSEN COIL DOPE WITH THINNER SO SLUG TURNS FREELY-- SEE NOTE UNDER 3-(G), PAGE 20.

(2) SET DETECTOR TUNING AND OSC FREQ CONTROLS MID-RANGE.

(3) ADJUST SLUG FOR A PEAK ON THE NULL INDICATOR. SEE NOTE AFTER PARAGRAPH C-1-(J), PAGES 17 & 18.

(4) CHANGE FREQUENCY ACROSS THE BAND, SIMULTANEOUSLY ADJUSTING DETECTOR TUNING CONTROL TO RETAIN THE PEAK.

(5) READJUST THE SLUG, AS REQUIRED, SUCH THAT THE DETECTOR TUNING CONTROL DOES NOT RUN OUT OF RANGE. MAKE SURE YOU ARE TRACKING THE PEAK MOST CCW ON THE DETECTOR TUNING CONTROL, AS THE OTHER ONE MAY RUN OUT OF RANGE.

(6) TO RE-APPLY COIL DOPE TO SLUG, ESTABLISH A REFERENCE PEAK THEN TURN SLUG IN COIL CW UNTIL A FEW THREADS SHOW. APPLY A SMALL AMOUNT OF COIL DOPE (AMPHENOL "912" OR EQUIVALENT) AND RE-SET SLUG TO SAME PEAK AS PREVIOUSLY ESTABLISHED AS REFERENCE.

(7) RECHECK PEAK ACROSS FREQUENCY BAND BEFORE COIL DOPE SETS-UP.

(H) 21-48 MC RANGE TRACKING (DETECTOR OSCILLATOR)

PROCEDURE IS SAME AS FOR 9-21 MC RANGE. AT FINAL ADJUSTMENT SLUG WILL USUALLY EXTEND APPROXIMATELY 1/8" OUT OF COIL FORM TOWARD CENTER OF CASTING. RE-DOPE SLUG.

(I) 48-110 MC RANGE TRACKING (DETECTOR OSCILLATOR)

PROCEDURE IS SAME AS 9-21 MC RANGE. SLUG POSITION IS SIMILAR TO 21-48 MC RANGE. BE SURE TO RE-DOPE SLUG.

(J) 110-250 MC RANGE TRACKING (DETECTOR OSCILLATOR)

THIS RANGE WAS ADJUSTED IN STEP (B) AND NEED ONLY BE RECHECKED AT THIS TIME TO ASSURE THAT DETECTOR TUNING CONTROL DOES NOT RUN OUT OF RANGE.

6. Final Checks and Reassembly

(A) Check that slugs and trimmers clear all other components as turret is rotated thru all ranges.

(B) Replace large nuts and smaller screws on casting.

(C) Replace dial, fiducial and mask making sure dial is in correct position and fiducials line-up properly with dial markings.

(D) Replace spring washer on OSC RANGE Shaft and put oscillator assembly back on panel.

(E) Replace oscillator side plate.

## BRIDGE UNIT ADJUSTMENT

The following adjustments are given to aid in the field calibration of the RX Meter.

Because of the wide frequency range over which the RX Meter operates (.5-250 MC), lead dress and component positioning become significant to proper operation. Although minor repairs and readjustments may be successfully made in the field, this work is best done by one thoroughly familiar with the intricacies of the Bridge Unit.

The RF transformer (T101) on top of the bridge, the HI and LO terminal posts, the R-Coarse and R-Fine Controls, the 6AB4 tube and components in its cathode circuit are field replaceable without extensive recalibration if care is taken in their replacement.

A. Bridge Unit Exchange Program

To make factory facilities conveniently available for field repairs to the RX Meter, Rebuilt Bridge Units are available on an exchange basis (BRC part no. 302051-R). Contact your -hp- Field Sales Office for details.

B. Cp Calibration

Field repair or replacement may be made of those parts associated with the Cp Control if facilities are available for precision measurement and calibration of capacitance.

1. Follow measurement techniques described in sect. II-B-3, page 12.

2. Bend serrated plates of Cp Rotor as required to obtain capacitance tracking within specifications. Start at Cp = 0.00 and make all measurements and adjustments with reference to that setting.

NOTE: When Cp = +20.00, the Cp Rotor should be just starting in to mesh with the Stator.

C. Rp Calibration

CAUTION: Since the Rp Dial is of necessity hand-calibrated to the characteristics of the individual bridge unit, adjustments, repairs, or replacement of any parts associated with its calibration will usually require marking and engraving of a new Rp Dial. Some recalibration is possible, as discussed below. Keep in mind, however, that each adjustment interacts to some degree with all others.

1. Check the accuracy of the Rp Dial as described in section II-B-2, page 11.

2. If Rp calibration is off and cannot be adjusted to within specifications with the techniques described in the following sections, it is recommended that advantage be taken of the Bridge Unit Exchange Program.

D. C109 Low Frequency Bridge Trimmer Adjustment (.5-1 MC Range)

If it is impossible to balance the bridge at any frequency, or if Rp calibration is only slightly out of specifications, adjustment of C109 may be attempted in the field.

The setting of C109 is extremely critical and upon it depends both the accuracy of the Rp Dial and the proper balancing of the bridge at all frequencies.

C109 was not intended as a field adjustment, but rather as a factory adjustment prior to the hand-marking and engraving of the Rp Dial. Keep in mind that if its proper setting is "lost" the marking and engraving of a new Rp Dial will in all probability be required.

C109 screwdriver adjustment is located about an inch and a half to the right, and slightly to the rear of the top plate plug button that covers C101. It can be seen down behind the top plate when the top cover of the instrument is removed.

To readjust C109 proceed as follows:

1. Set the frequency to .5 MC and the Rp Dial to $\infty$.

2. Adjust the DETECTOR TUNING Control in the normal manner for maximum deflection of the NULL INDICATOR.

3. Position both the "R-Coarse" and "R-Fine" balance controls so they are exactly mid-range.

4. Turn the "C" balance knob fully clockwise.

5. Using the Cp Control and the trimmer C109 mentioned above, balance the bridge. This should occur at zero or within 10$\mu\mu$f in the silver portion of the Cp Dial. For the final balance, a slight adjustment of the "R-Fine" balance might be necessary.

6. Using 1/2% precision film resistors, check the accuracy of the Rp Dial at 10 K and 200 ohms (frequency still at 0.5 MC).

   (a) If the 200Ω resistor reads <u>low</u> turn the "R-Coarse" knob a little more counterclockwise and repeat steps above.

   (b) If the 200Ω reads <u>high</u> turn "R-Coarse" knob clockwise and repeat as before.

7. Measure the 200Ω resistor at 250 MC. A DALE type CAH-1/2, 200Ω ±1/2% resistor should measure 194Ω to 198Ω. If it does not try "strap" adjustment.

E. <u>C101 High Frequency Bridge Trimmer Adjustment</u> (110-250 Range)

At frequencies above 100 MC the zero balance of the RX Meter bridge circuit is necessarily sensitive to extremely small variations in internal circuit capacitance. It is possible that minute shifts in the relative position of circuit components, caused by excessively rough handling in shipping, etc., may alter the effective capacity enough to make it impossible to obtain a null indication on the highest frequency range by adjusting ZERO BALANCE Controls, "R" and "C".

In most cases, this situation can be corrected by the following screwdriver adjustment:

1. Allow the instrument to warm up, set the oscillator frequency at 200 MC, and adjust the DETECTOR TUNING Control for a peak on the NULL INDICATOR (HI and LO terminals temporarily shorted; Cp Dial at 0 and Rp at ∞).

2. With a screwdriver pry up the small metal cap located near the rear of the top plate. This provides access to a small trimmer capacitor having a vertical slotted adjusting shaft. A2-C6

3. Rotate the "R-Coarse" knob and note whether the NULL INDICATOR reading decreases with clockwise or counter-clockwise rotation.

4. Using the screwdriver rotate the trimmer shaft about 1/8 turn clockwise if the "R" knob was clockwise above or counterclockwise if the "R" knob was counterclockwise above. Remove the screwdriver and try to obtain balance with the "R" and "C" knobs. If a null indication still cannot be obtained, rotate the trimmer another 1/8 turn in the same direction. Continue this procedure until balance can be obtained.

<u>NOTE</u>: Correct null indication can <u>not</u> be obtained while the screwdriver (or aligning tool) is near or in contact with the trimmer shaft.

5. If correct adjustment of C101 cannot be obtained try "Loop" adjustment in next section.

6. Check the balance at a frequency of 250 MC and repeat the above adjustments if necessary.

F. "Loop" Adjustment

The need for this adjustment is indicated by the lack of range of C101 when making adjustments as described in the previous section.

The positioning AND length of the wire leads between R111, C101 and T101 are extremely critical and are actually positioned in such a manner as to keep the "R" balance controls within range of balance adjustment when operating on the 110-250 MC range. The inductance of these leads has a significant effect on the frequency compensation of the Bridge Unit at these higher frequencies.

The "Loop" is the arched lead between C101 and T101, and can be seen only when the top plate is removed. The lead length (inductance) of primary interest is composed of the straight lead of R111 up to the "Loop", then over to T101 on top of the Bridge Unit. Adjustments are made by unsoldering tack-soldered junction of R111's lead at the "Loop", and repositioning the lead along the "Loop" to increase or decrease lead length (thus inductance) between R111 and T101.

NOTE: Do not change shape of leads, just the position on the "Loop" where R111 connects. The lead of R111 should be straight and will protrude beyond the "Loop"; do not cut this lead off. The "Loop" should form a smooth arc from C101 to T101.

To obtain proper positioning proceed as follows:

1. Set OSC RANGE Switch to 110-250 MC; OSC FREQ Control to 250 MC.

2. Set Cp to 0; Rp to $\infty$.

3. Position R-Coarse and R-Fine balance controls so they are exactly mid-range.

4. Adjust C101 as described in section IV-E, page 26 to obtain bridge balance. If unable to obtain balance and C101 runs out of range in a full CW position, the lead length between R111 and T101 must be shortened. If C101 runs out of range in full CCW position, lead must be lengthened. Proceed as follows:

(A) Insert screwdriver thru hole in top plate and reset C101 mid-range. (Do not move "R-Coarse" or "R-Fine" Controls in this procedure).

(B) Change Rp Dial to obtain bridge balance.

(C) Shorten "Loop" and recheck position of balance on Rp Dial. Continue to adjust length of "Loop" until Rp balances at $\infty$.

(D) Check balance of bridge at 200 MC, 170 MC, 150 MC, 130 MC and 110 MC. Balance at these (or any other) frequencies should be within range of the front panel balance controls.

(E) If balance cannot be obtained across the frequency band slightly readjust "Loop" in the following manner:

(1) If "R-Coarse" is full CW, ADD slightly more lead length between T101 and R111. Reset C101 at 250 MC, as previously described.

(2) If "R-Coarse" is full CCW, slightly SHORTEN lead length and reset C101.

(3) Recheck as in (D) above.

(F) Check a DALE type DCH-$\frac{1}{2}$ 200Ω precision resistor at 250 MC; it should measure between 194-198Ω. If not, re-adjust "Strap" as described in the following section.

## G. "Strap" Adjustment

The "Strap" is the ribbon-like conductor between C105 and the stator of the Cp Capacitor. It is located between the top of the "network" can and connection of the C-balance vane and the Cp Capacitor. The main effect of its position is upon the Rp accuracy around 200Ω when measured at 250 MC.

1. To INCREASE dial reading when measuring a 200Ω resistor, move the "Strap" FURTHER AWAY from the Cp stator block toward the front panel. Conversely, to decrease dial reading move "Strap" closer to stator of Cp. Be sure not to short circuit lead of "Strap" where it emerges from "network" can.

2. The position of the "Strap", near the connections of the C-balance vane and the Cp stator, should be such that it is closer to the stator than it is to the vane. Positioning should be done primarily with the lower portion of the "Strap".

3. Moving the position of the "Strap" affects the setting of C101 so it must be readjusted as described in section IV-E, page 26.

## H. C104 and C105 Balanced Coupling Capacitor ("Network") Adjustment

NOTE: This adjustment is seldom if ever required after initial adjustment at factory. Should the adjustments inadvertently be moved readjustment may be made as follows:

1. Turn instrument OFF; remove top cover and top terminal plate.

2. Disconnect all resistors soldered to the Cp stator (HI terminal post).

   USE CAUTION: Do not apply excess heat, only enough to loosen tack-soldered leads.

3. Set Cp Capacitor to minimum capacitance (beyond +20μμf on Cp Dial).

4. Connect balanced coupling capacitors directly to the two secondaries of the Bridge transformer, T101, as follows:

   (a) Connect a short piece of #18 wire from the HI terminal post to one of the output leads on the front left side of the transformer, T101.

   CAUTION: Do not disturb lead dress at transformer.

   (b) Remove rear plate from Bridge Unit and connect another short piece of wire from the right angle SHIELD of Rp Capacitor (C103) to the other output lead of T101.

   TAKE CARE not to disturb the relative position of ANY components or leads.

5. Turn power switch ON; allow to warm up.

6. Set OSC FREQ to .5 MC and "peak" using DETECTOR TUNING Control. If a "peak" can only be approached, but not obtained, increase frequency just far enough to obtain a true "peak" on the NULL INDICATOR.

7. Adjust C101 and/or C105 for a minimum indication (less than 12 divisions) on NULL INDICATOR. These are accessible thru holes in the small can just under the Cp Capacitor in the center of the Bridge.

NOTE: Usually it will only be necessary to "touch-up" one of the adjustments. It is good practice to keep the screws as far CCW as possible while still retaining good balance. This makes the adjustment less critical and more stable.

8. Restore wiring to original condition and reassemble unit.